Supplemental Material

Private Drinking Water Wells as a Source of Exposure to PFOA in Communities Surrounding a Fluoropolymer Production Facility

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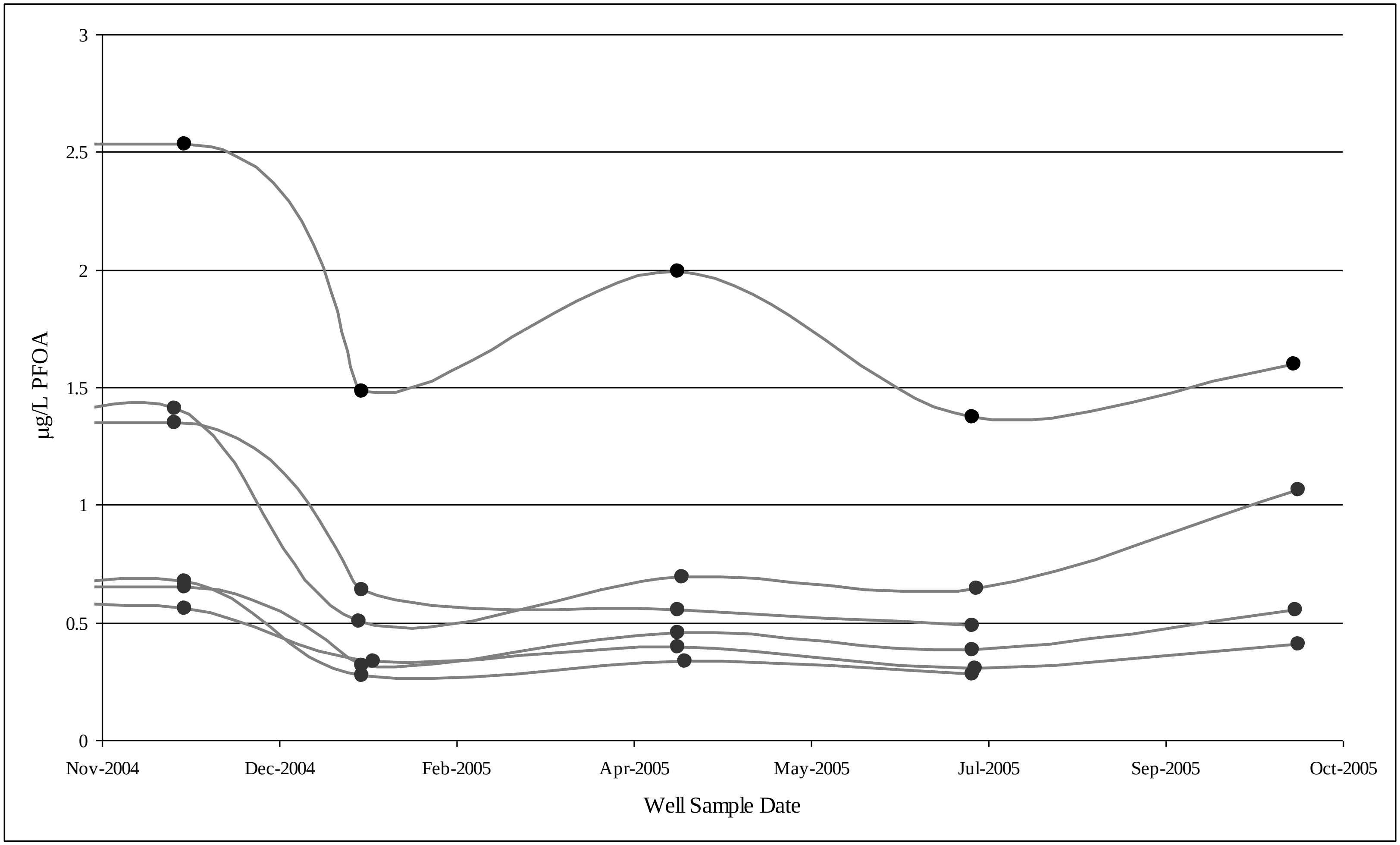

Supplemental Material, Figure 1: Time variation in well PFOA concentration.
PFOA concentration (µg/L) in a subsample of 6 wells measured at least 4 times between November 2004 to October 2005 (other wells had fewer measurements during this time period). Black circles indicate sampling points. We have connected the points to make it easier to distinguish measurements taken in the same well; these lines may not represent the actual well PFOA concentration.

Non-steady state pharmacokinetics:

For participants on a private well with PFOA levels that varied over time, steady-state models could provide inaccurate estimates of serum PFOA levels. Although data on the changes in PFOA concentrations over time were not collected in all wells, multiple measurements of PFOA were taken in 11 wells during the study period. We therefore performed another regression model using time-weighted well concentrations (rather than arithmetic average as before). The time-weighted concentration was derived from the non-steady state model given by (Bartell 2003):

$$C_s(t_q) = \sum_{j=1}^{q} \frac{fQC_{wj}}{kV_d} \cdot \left(1 - e^{-k(t_j - t_{j-1})}\right) \cdot e^{-k(t_q - t_j)} \quad [1]$$

where $C_s(t_q)$ is the serum PFOA concentration at time q, Q is the daily water intake (L/d), C_{wj} is the concentration of PFOA present in drinking water during time period j (μg/L), f is the fraction of PFOA absorbed, k is the first-order rate constant for PFOA elimination (day^{-1}), and V_d is the apparent volume of distribution (L).

Bringing the constants out from within the summation, equation 1 the blood concentration (C_s) is given as a function of the constants (f, Q, k and V_d) and the time-weighted water concentration ($\overline{C_w}$):

$$C_s(t_q) = \frac{fQ}{kV_d} \sum_{j=1}^{q} \alpha_j C_{wj} = \frac{fQ}{kV_d} \overline{C_w} \quad [2]$$

The time-weighted water concentration $\overline{C_w}$ computed using the weights α_j is given by:

$$\overline{C_w} = \sum_{j=1}^{q} \alpha_j C_{wj} \qquad [3]$$

The weight during each time point is give by:

$$\alpha_j = \left(1 - e^{-k(t_j - t_{j-1})}\right) e^{-k(t_q - t_j)} \qquad [4]$$

We included the time weighted PFOA concentration in well in regression models based on these equations. PFOA concentrations in each well varied by season, but in general there did not seem to be a long-term trend from 2001 to 2005 in the concentrations in each well; the arithmetic and time-weighted concentrations were very similar. Consequently, using either method produced a similar estimate of the ratio of serum to drinking water PFOA concentrations.

References:

Bartell S. 2003. Statistical methods for non-steady state exposure inference using biomarkers. [PhD Dissertation]. Davis, CA: University of California, Davis.